

A non-LTE analysis of Mg I lines in the atmospheres of late-type stars

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Abstract

The formation of Mg I lines in the atmospheres of stars with $T_{\text{eff}} = 5500\text{--}7000\text{ K}$, $\log g = 2.0\text{--}4.5$, and $[A] = 0, -2$ is analyzed. It is shown that the Mg I level population is a nonequilibrium one, and that overionization takes place. This is the chief cause of departures from LTE in the equivalent widths of strong lines; for weak lines, the shift in the depth of their formation in the stellar atmosphere also plays a major role. Quantitatively, overionization is more pronounced in metal-poor stars. Departures from LTE grow with increasing stellar luminosity, peaking at $T_{\text{eff}} = 6500\text{ K}$ in main-sequence stars and growing with decreasing T_{eff} in giants. Non-LTE magnesium-abundance corrections are calculated. They are at their peak for the $\lambda 4571$, $3829\text{--}3838$, 5172 , and 5183 lines and reach 0.30 dex at $T_{\text{eff}} = 5500\text{ K}$, $\log g = 2.0$, and $[A] = -2$. For the $\lambda 4057$, 4167 , 4702 , 4730 , 5528 , and 5711 lines, the non-LTE corrections do not exceed $+0.15\text{ dex}$ for the entire range of physical parameters studied. The sensitivity of the results to variations in the input data (model atom, cross sections for the processes, etc.) is analyzed.
